PE 31

Physical Activities Towards Health and Fitness 1

MOVEMENT COMPETENCY TRAINING

CENTRAL MINDANAO UNIVERISTY

Physical Education Department

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LEARNING UNIT 2

POSTURE AND BODY MECHANICS

TIME ALLOTMENT

This learning guide will be discussed for six (6) hours, equivalent to 3 sessions

INTRODUCTION

Right now you are reading your learning guide. I want you to be aware of your body position. Where is your head in relation to your shoulder? How about in relation to your hips? Visualize and remember that. Later while reading this guide, I want you to determine if that position is ideal for your body. In this learning guide you will learn the body systems involved in maintaining good posture and body mechanics and why it is important. Furthermore, you will learn exercises that will help you stretch your muscles to relieve them of stress.

LEARNING OBJECTIVES

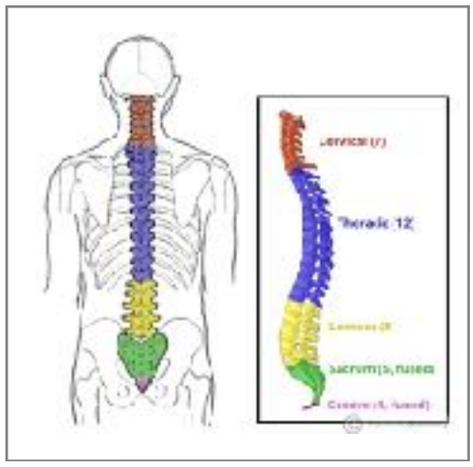
At the end of this unit the students should have:

1. executed exercises that are good for the back
2. displayed deep appreciation on the importance and benefits of proper posture; and,
3. identified the function of the spine & core muscles in maintenance of good posture and body mechanics.

TOPICS

Anatomy and Function of the Spine.

The spinal column is arranged for movement. The bones that make up the spine is called the vertebrae. There are 33 vertebrae in the spine and most are separated by an intervertebral disc.



Picture 1. The Spinal Column

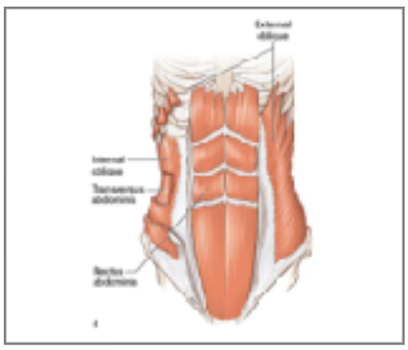
<u>Three main regions</u>

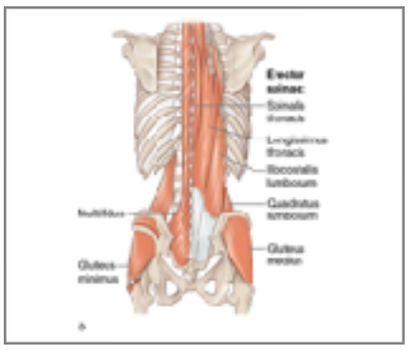
Cervical (neck), thoracic (upper back), lumbar (low back) (See photo) make up the vertebral column. Fused vertebrae that from the tailbone are called the sacrum and coccyx. The spine is capable of flexion (forward bending), extension (backward bending, side bending and rotation. The spinal column has an important role in bearing loads and protecting the neck and back from injury.

The widest portion of each vertebrae articulates with the intervertebral disc to form a strong pillar of support extending from the skull to the pelvis. The unique structure of the intervertebral discs is critical in distributing force and absorbing shock. The bony structure of the spine bears loads and

provides protection to the spinal cord and spinal nerves. **Poor posture and poor body mechanics can damage discs and vertebrae, resulting in pain and disability.**

Anatomy and Function of the Core Musculature





Picture 2.Muscles in the core. a) front; b) back

The core is part of an integrated system that provides stability to the spine.

The core includes musculature of the abdominals, back extensors, lateral trunk flexors, diaphragm, pelvic floor, and hips. A few more familiar muscles of the core include the lumbar multifidus, transverses abdomens, and internal oblique. There is no definitive list of muscles belonging to the core. Some source may describe the core in terms of 6 or fewer key muscle groups, while other sources include as many as 20 different muscle groups. Regardless, muscles of the core all share a common anatomical trait: their location and attachment to either spine, pelvis, or rib cage. Collectively, the core musculature form a three-dimensional cylinder that encompasses the body's center of gravity. This three-dimensional cylinder is inclusive of the lumbar, spine, pelvis, and hips.

Core stability refers to the body's ability to maintain the spine in a "neutral" postural zone, one in which the physiologic load on the spine is minimized.

Muscles of the core are commonly classified as either mobilizer or stabilizers.

In general, the **mobilizers are those muscles that are more superficial and contract concentrically to produce trunk movements.** The **stabilizers** are muscles that are more deeply located and contract isometrically or eccentrically to **stabilize the trunk during arm and leg movements**. The stabilizer group is further divided into two categories: local and global. These groups are distinguished by difference in anatomy and function.

The local group stabilizers provide stiffness and stability to the spine. They include muscles that posses a small cross-sectional area, are deeply located, and may span just one or two vertebral levels at a time. Functionally, these muscles provide local spinal support, control motion between adjacent vertebrae, increase intra-abdominal pressure, and provide proprioceptive input to the body to avoid injury. The most notable example of a local core stabilizer is the lumbar multifidus.

Global core stabilizers function to produce trunk motion as well as trunk stability based on their attachments to the pelvis. These muscles tend to have a larger cross-sectional area, are more superficially located, often span multiple vertebral levels, and possess attachments to the pelvis, rib cage, and/or thoracic spine. Examples include the rectus abdomens, external oblique, quadrates lumborum, and erector spinae.

Causes and Consequences of Back Pain and Neck Pain

Most back and neck pain stems from lifestyle choices or life experiences.

The original cause (or causes) of back and neck pain are typically hard to identify. Although back and neck problems can result from an acute injury (e.g., a diving accident or car accident),

most are caused by accumulated stress over a lifetime. These factors include the avoidable effect of poor posture and body mechanics as well as questionable exercises that put the back at risk. Musculoskeletal injuries and degenerative changes to the discs, vertebrae, joint surfaces, muscles, or ligaments can predispose you to back and neck problems. Depression, cancer, infections, and some visceral diseases (kidney, pelvic organs) can also contribute to back problems. Although people have some control over these causes, some back pain stems directly from structural or functional disorders that a person is born with. Inherited causes include anomalies of the spine and some forms of scoliosis.

To reduce risk of back pain, reduce the risk factors that you have control over. Modifiable risk factors include regular heavy labor, use of vibrational tools, routines of prolonged sitting, smoking, a hypo-kinetic lifestyle, coronary artery disease, and obesity. Non-modifiable risk factors include family history of joint disease, age, congenital anomalies, and direct trauma.

The nervous system and various pain-sensitive structures contribute to back pain.

Back pain can result from direct to indirect causes. Direct causes are typically the result of tissue trauma to areas in or around the spinal column. The most common sources of pain are ligaments, intervertebral discs, nerve roots, spinal joints, and muscles. Indirect causes come from the release of pain-causing chemicals from injured tissues. These chemicals cause nerves in the area to remain irritated and sensitive. Processes within the brainstem, spinal cord, and peripheral nerves can also modulate the sensation of pain, either increasing or decreasing it. For example, some back pain can be caused by abnormal feedback loops that enhance or maintain the perception of pain- even when the original cause or problem is corrected.

The integrity of the neck and back are jeopardized by excessive stress and strain.

Forces are constantly at work to bend, twist, shear, compress, or lengthen tissues of the body. Stress on these tissues may eventually create strain, a change in the tissue's size or dimension. Healthy tissues typically return to their normal state once the force is removed. Injury occurs when excessive stress and strain prevent the tissue from returning to its normal state. A number of factors can contribute to stress and strain on the back.

Poor posture can cause body segments to experience stress and strain**.** When body segments are in poor alignment (slouching or forward head positions), the muscles in the back and neck must work hard to compensate. This creates excessive stress and strain in the affected area(s). Over time, tension in these muscles can lead to myofascial trigger points, causing headache or referred pain in the face, scalp, shoulder, arm and chest. The chronic stress from poor alignment can also lead to other postural deviations and degenerative changes in the neck.

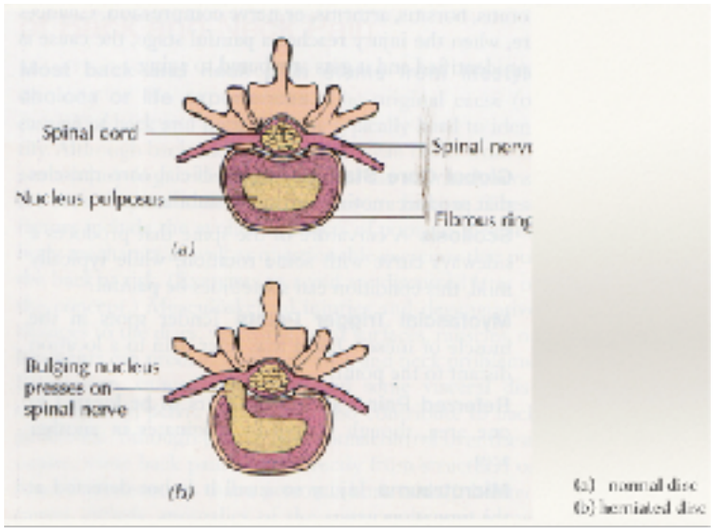
Prolonged sitting contributes to back problems. Sitting, by itself, is not a risk factor for the development of back pain. However, when prolonged sitting is combined with exposure to vibration and awkward postures at work, an individual has four times the risk of developing back pain. Occupations with the highest risk based on these three factor include helicopter pilots and truck drivers.

Bad body mechanics and improper lifting techniques contribute to stress and strain on the spine. The lumbar vertebrae and the sacrum are most vulnerable to this type of injury due to the significant weight they support and the thinner ligamentous support at this level.

Being overweight or obese increases the risk of back pain. This who are obese are on average 20 percent more likely to have back pain than those of normal weight. Obesity and overweight status are hard on the body because they overload the bones, discs, tendons, and ligaments of the body. Added wear and tear on joint surfaces can lead to osteoarthritis. Postural changes accompany weight gain and create additional stress and strain on joints. For example, a

large protruding abdomen often causes forward tipping of the pelvis and excessive arching of the low back that can lead to back pain.

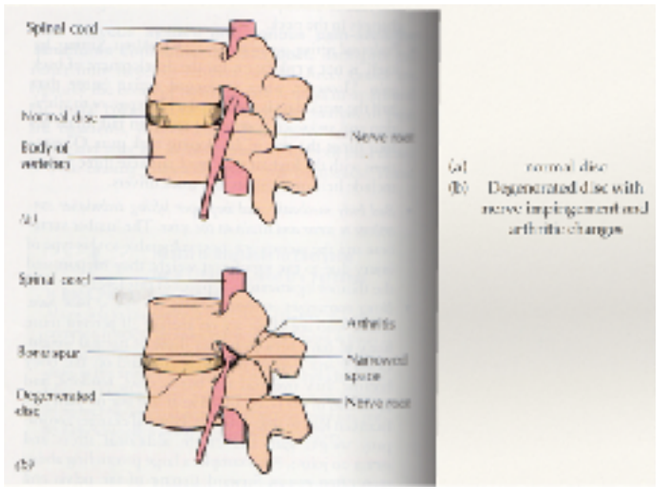
The lumbar intervertebral discs are particularly susceptible to injury and herniation.



Picture 3. A) normal disc b) herniated disc

The intervertebral discs located between the vertebrae are composed of a tire like outer ring: fibrous ring surrounding a gel-like center nucleus pulposus (see photo a). The greatest risk of injury to the discs occurs during excessive loading and twisting motions of the spine. While most people think that disc injuries occur from an acute injury, disc herniation typically reflects a degenerative process that takes place over time. With repeated microtrauma, small tears begin to occur in the inner fibers of the annulus. The nucleus begins to move outward: herniated disc (see photo b), much like toothpaste moving with squeezed tube.

The risk of disk herniation is great for younger adults. Disc herniation is frequently listed as a cause of back pain, but studies show that only 5-10 percent of persons with herniated discs experience pain. The reason for this is that pain is often not experienced until complete herniation occurs. This happens when the nucleus pulposus moves into the space around the spinal cord or nerve root. Pain is felt as the nuclear material begins to press on pain-sensitive structures in its path. Interestingly, the risk of disc herniation is greatest for individuals in their 30s and 40s. Risk decreases with age as the disc degenerates and becomes less soft and pliable.



Picture 4. a) normal disc; b) degenerated disc

Degenerative disc disease is a common part of aging and a source of back pain. Many elderly adults get shorter as they age, often due to degenerative changes within the vertebral bodies and discs. One notable change is flattening of the discs as a result of lost water content. This reduces the space between vertebrae and increases the compressive forces on the small facet joints and the large vertebral bodies. This results in a decrease in the size of the intervertebral discs, which in turn increases the likelihood of nerve impingement, bone spur development, and arthritis, all of which can contribute to back pain and disability.

Picture 5. Core Stabilization exercises.

Prevention of and Rehabilitation of Back and Neck Problems.

Exercise is a frequently prescribed treatment for back and neck pain. Exercise, such as resistance and aerobic exercises, had been found to be helpful in treating many types of chronic pain. Exercises that are selected

specifically to help pain related problems are classified as therapeutic. These exercises are aimed at correcting the underlying cause of neck or back pain by strengthening weak muscles, stretching short ones, and improving circulation to and nourishment of tissues of the body. Both therapeutic and health-related fitness exercises may be considered preventive. Done faithfully, and with the appropriate FITT formula, they improve the health of the musculoskeletal system, allowing greater efficiency of function and reduced incidence of injury.

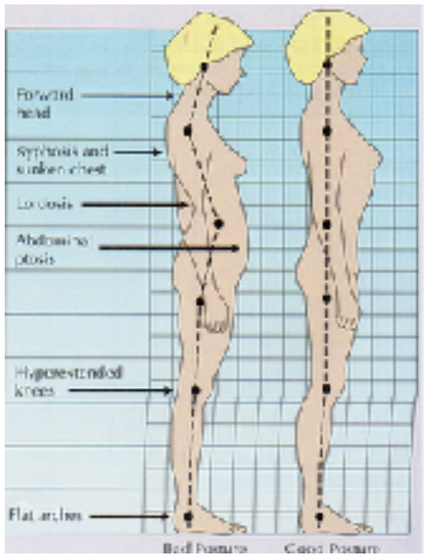
Specific core stabilization exercises may reduce low back pain and functional disability. Core stability training and core strengthening training can promote good back health. Resistance exercise can often correct muscle imbalance, the underlying cause of many posture and back problems.

Elements of good posture and body mechanics

Good posture is important for neck and back health

Good posture has aesthetic benefits. Posture is an important part of nonverbal communication. The first impression a person makes is usually a visual one, and good posture can help convey an impression of alertness, confidence, and attractiveness.

Proper posture allows the body segments to be balanced. Segments of the human body (ie. The head, shoulder girdles, pelvis girdle, rib cage, and spine) are balanced in a vertical column by muscles and ligaments. Proper posture helps maintain an even distribution of force across the body, improve shock absorption, and minimize the degree of active muscle tension required to maintain upright posture.



Picture 6. Bad and Good posture

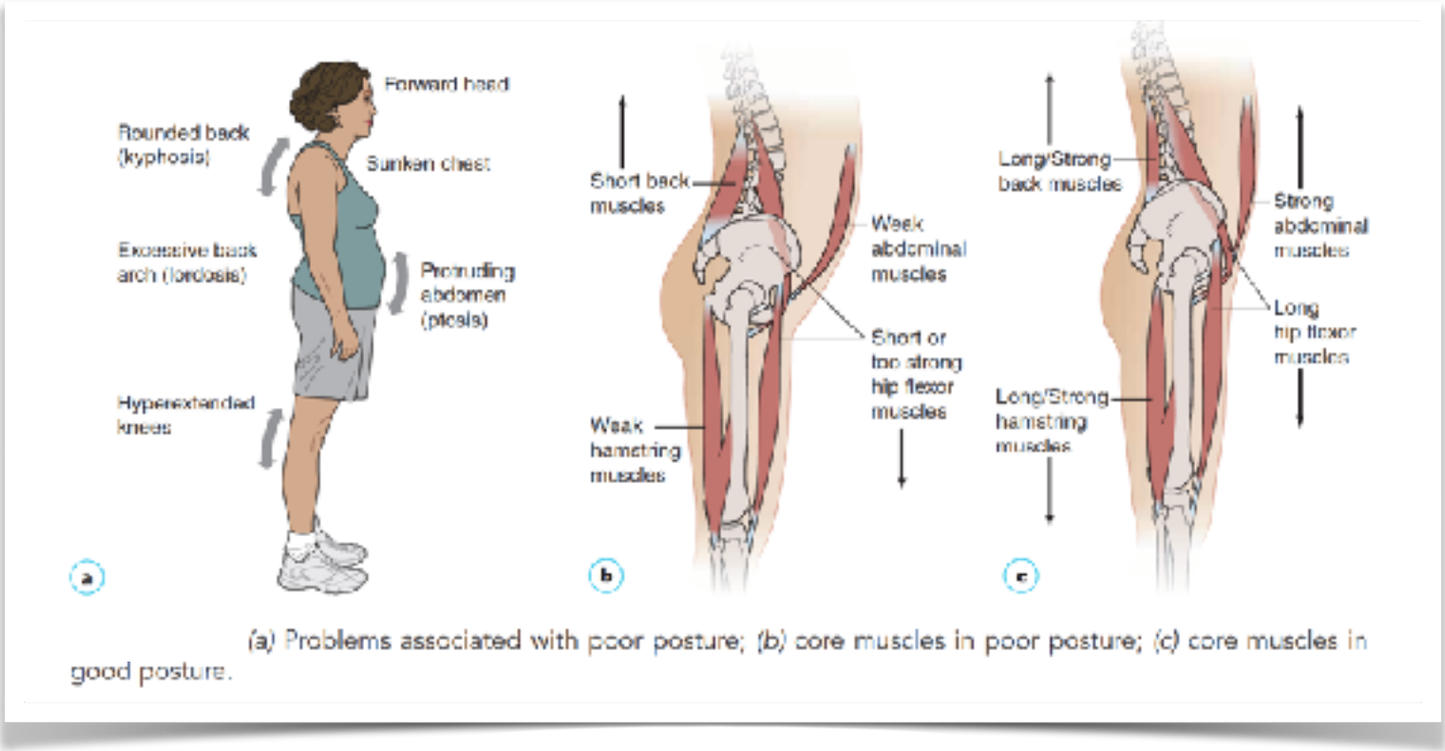
Health Problems Associated with Poor Posture		
Posture Problem	Definition	Health Problem
Forward head	The head aligned in front of the center of gravity	Headache, dizziness, and pain in the neck, shoulders, or arms
Kyphosis	Excessive curvature (flexion) in the upper back, also called humpback	Impaired respiration as a result of sunken chest and pain in the neck, shoulders, and arms
Lumbar Lordosis	Excessive curvature (hyperextension) in the lower back (swayback with a forward pelvic tilt	Back pain and/or injury, protruding abdomen, low back syndrome, and painful menstruation
Flat back	Reduced curvature in the lower back	Back pain, increased risk for injury due to reduced shock absorption
Abdominal ptosis	Excessive protrusion of abdomen	Back pain and/or injury, low back syndrome, and painful menstruation
Hyperextended knees	The knees bent backward excessively	Greater risk for knee injury and excessive pelvic tilt (lordosis)
Pronated feet	The longitudinal part of the foot flattened with increase pressure on inner aspect of foot	Decreased shock absorption, leading to foot, knee and lower back pain

Table 1. Health Problems Associated with Poor Posture

Poor posture contributes to a variety of health problems. When the body does deviates from the neural posture, weight distribution became uneven and tissues are at risk for injury. Examples of common postural deviations are described at Table 1, along with associated health problems.

Correcting postural deviations begins with restoring adequate muscle fitness and muscle length.

Most of us have a natural tendency to sit or stand with poor posture. For the most part, we can correct our posture with conscious effort. However if poor posture is maintained for very long or very frequent periods of time, the body loses resiliency. With poor posture, muscles on one side of a joint or body segment can become shortened or tight while muscles on the opposite can become lengthened and weak. Poor posture can also result following muscle injury. This may manifest itself in guarded postures or muscle dysfunction, which eventually leads to muscles on one side of the joint becoming more inflexible due to facilitation and muscles on the opposite side becoming weak due to inhibition. Postural correction can be achieved by improving body awareness, increasing flexibility of tight muscles and improving strength of weak (inhibited) muscles. (See picture 7) For example, a slouched posture with rounded and forward shoulders can be improved by elongating the pectoralis (chest) muscles and strengthening muscles of the upper back. A lumbar lordosis posture can be improved by stretching the hip flexors and back extensors that keep the top of the pelvis tipped forward, followed by strengthening of the abdominal and gluteal muscles that help tip the pelvis backward.



(a) Problems associated with poor posture; (b) core muscles in poor posture; (c) core muscles in good posture.

Picture 7.

Hereditary, congenital and disease conditions, as well as certain environmental factors, can cause poor posture.

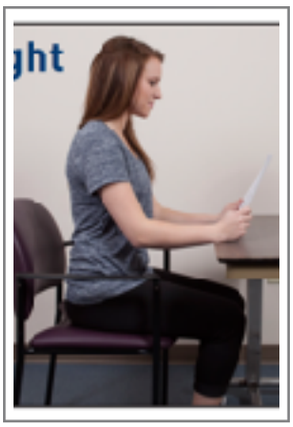
Some environmental factors that contribute to poor posture include ill-fitting clothing and shoes, chronic fatigue, improperly fitting furniture (including poor chairs, beds and mattresses) emotional and personality problems, poor work habits, poor physical fitness due to inactivity, and lack of knowledge relating to good posture. Some posture problems, such as scoliosis, may be congenital, hereditary, or acquired but can be improved with exercise, braces, and/or other medical procedures. Early detection is critical in treating scoliosis.

Good Body Mechanics for Back and Neck Health

Proper body Mechanics can help prevent neck and neck injury. Biomechanics is a discipline that applies mechanical laws and principles to study how the body performs more efficiently and with less energy. Good body mechanics, as applied to back care, implies maintaining a neutral spine during activities daily living. A neutral spine maintains the normal curvature of the spine, thus allowing an optimal balance of forces across the spine, reducing the compressive force, and maintaining muscle tension.
In the following sections, specific recommendations and exampled of good body mechanics are provided for a variety of body positions.

Elements of Good Posture

Sitting



•Sit upright, eyes looking straight ahead, chest lifted, shoulders down and back, slight arch in lower back, knees slightly lower than hips, feet supported on firm surface
•If you cross your legs, alternate every now and then
•Use chair with arm rest, seat cushion, lumbar support

Standing

•Stand upright with forward gaze, shoulders down and back, chest raised, stomach pulled up and in, slight arch in the lower back, slight bend in the knees, feet shoulder width apart, and toes pointing straight ahead or slightly outward
•If you stand with weight shifted to one side, alternate which leg you lean on
•If you stand in one place for a prolonged time, prop one foot on small step stool
•Height of work surface should be 2 to 4 inches below the waist.

Lying

- Use pillow between knees when lying on your side and under the knees when lying on the back
- Choose a pillow that supports the head and neck in neutral alignment
- Avoid reading in bed

Elements of Good Body Mechanics

Reaching

- Use a stool or ladder when working with arms above head level
- Keep tools within easy reach
- Choose tools with extended handles
- Don’t keep arms extended out in front or out to side for long period of time without rest
- Don’t hyperextend your neck
- Avoid bending, twisting, and straining when reaching.

Carrying

- Keep load midline and close to the body
- Divide the load if possible, carrying half in each arm/hand
- Alternate load from one side of the body to the other when it cannot be divided. (e.g. child)
- Carry light to moderate loads in a backpack with straps.

Lifting

Keep in mind that the muscles of the legs are relatively large and strong, compared with the back muscles. Likewise, the hip joint is well designed for motion. It is less likely to suffer the same amount of wear and rear as the smaller joints of the spine.

- DO

- Keep a slight arch in the lower back, bend with the knees, straddle and test the load, keep load close to the body, tighten abdominals, lift using legs.
- Lower a load with the same principles in reverse

- Don't
  - Bend at the waist
  - Twist
  - Lift more than what you can handle
  - Hyperextend the neck or back

For better back health we need to strengthen our abdominal muscles, hamstring and back muscles. We also need to stretch or elongate our hip flexor, hamstrings, and back muscles. The following are exercises that you can do while sitting down (you can do these while at work or when taking a break from studying, when traveling) and exercises to strengthen your core muscles.

Exercises Good for the Back and Neck

Watch the video for instructions. Video link will be given by the professor/instructor.

Chair Exercises

Neck Retraction

An exercise that targets the cervical (neck) area of the spine.

Preparatory:

1. Bring the body into proper alignment by having your shoulders and hips aligned and the spine straight.

Execution

1. Inhale, exhale as you retract your chin backwards and hold that for five seconds.
2. Breathe naturally
3. After five seconds relax, return your neck to normal position.
4. Repeat 4 times.

Note: During each repetition, proper alignment and position of the spine should be maintained.

Shoulder Blade Retraction

An exercise that targets you chest area by lengthening your pectorals major.

Preparatory:

1. Sit at the edge of the chair.
2. Bring the spine into proper alignment, feet planted on the floor, knees aligned with the toes.
3. Bring the hands around the back, palms stack on top of each other, facing upwards and towards the ceiling.

Execution:

1. Inhale, as you exhale draw your shoulder blades in towards the center and half the

retraction for five seconds.
2. As you feel the squeeze in the middle of your upper back, breathe naturally.
3. After 5 seconds, relax.
4. Repeat 4 times.

Note: During each repetition, proper joint alignment should be maintained.

Abdominal Stretch

An exercise that aims to lengthen your abdominal muscles.

Preparatory:

1. Sit at the edge of the chair.
2. Bring the spine into proper alignment, feet planted on the floor, knees aligned with the toes.
3. Sit nice and tall and bring the hands around the low back area on either side. Bring your elbows towards the middle (as far as you can), pointing backwards

Execution:

1. Inhale, Exhale and gently push in with the hands on the lower back area while hollowing the lower back.
2. Shoulders should move backward then hold the position for 5 seconds.
3. Breathe naturally and after 5 seconds, relax.
4. Repeat 4 times.

Note: During each repetition, line of sight can be slightly higher than the horizon

T-Spine Rotations.

An exercise that improves of rotational movement pattern, the flexibility and mobility of the spinal and hip area.

Preparatory:

1. Sit at the edge of the chair.
2. Bring the spine into proper alignment, feet planted on the floor, knees aligned with the toes.
3. Bring your hands behind your head, fingers interlaced, elbows pointing to the sides.

Execution:

1. Inhale. As you exhale gently rotate to the left side. Hold. Dip to the side, come back up to the rotated position.
2. From that rotated position, gently twist to the left again. Hold. Dip to the side, come back up to the rotated position.
3. From that rotated position, gently rotate for the third time. Hold. Dip to the side, come back up to the rotated position.
4. Gently rotate back towards the center
5. Repeat on the right side.
6. Repeat both sides.

Reminder: Throughout the exercise, breath naturally

Note: Persons with scoliosis, please refer to the modification of this exercise to be given by your professor/ instructor

Hamstring Stretch
An exercise that lengthens the muscles at the back of your leg (hamstring).

There are two variations to this exercise. First is when both legs are fully extended, the other is one leg is fully extended

Preparatory:
1. Sit at the end of the chair.
2. Bring the spine into proper alignment by sitting straight, ears and shoulders aligned.
3. Fully extend the leg, feet flexed, toes pointed towards the ceiling.
4. Hold your arms straight, parallel to your legs

Execution:
1. Inhale. As you exhale, slowly bend from the hips without rounding the back.
2. Stop bending when you feel the tension in the back of your leg and your knees are starting to bend.
3. Hold that position for 5 seconds while creating naturally.
4. Return to starting position.
5. Repeat 4 times.

Note: keep your back straight as you bend your hip.

To perform the hamstring stretch with one leg fully extended. The movement pattern is the same as the two leg fully extended however, the other leg is fully extended, while the other leg is planted on the ground, knees bent 90 degrees and aligned with the toes.

Ankle Mobility and Stretching
Helps increase circulation in the ankle area and increase flexibility.

Preparatory:
1. Plant the feet on the floor, knees bent 90 degrees and aligned with the toes.
2. Bring the spine into proper alignment by sitting straight, ears and shoulders aligned.

Execution:
1. Raise the right leg a few inches off the ground.
2. Slowly make 4 small circles counter clockwise, then 4 small circles clockwise without touching the ground.
3. Return your leg to the preparatory position.
4. Repeat with left leg.
5. Repeat 2 times.

Note: maintain proper posture while performing the exercise.

Core Exercises for Back Pain

Cat Cow Stretch

Mc Gill Curl-Up

Version 1

Version 2 (elbows off)

Side Plank

Version 1 (Bent Leg)

Version 2 (Straight Leg)

Hip Bridge

Version 1

Version 2 (bent knees)

Version 3 (straight legs)

PERFORMANCE TASK

Students in PE Uniform will perform the Chair Exercise and Core Exercise listed below. Number of Repetitions and/or time to hold the exercise is indicated on the table below. The rubrics below indicate the criteria for rating the student's performance.

Exercises for the back and neck	**Repetitions**
❖ Chair Exercises	
❖ Neck Retractions	4 / 5 second hold
❖ Shoulder Blade Retractions	4 / 5 second hold
❖ Abdominal Stretch	4 / 5 second hold
❖ T-Spine Rotations	2 / 5 second hold
❖ Hamstring Stretch	4 / 5 second hold
❖ Ankle Mobility and Stretching	2 / 4 rotations clockwise and counterclockwise
❖ Core Exercises	
❖ Cat-Cow Stretch	4
❖ Mc-Gill Curl-Up v.1	2 / 5 second hold
❖ Mc-Gill Curl-Up v.2 Elbows off	2 / 5 second hold
❖ Side Plank v.1 (bent leg)	2 reps/ 5 secs each side
❖ Side Plank v.2 (straight leg)	2 reps/ 5 secs each side
❖ Hip Bridge v. 1	4 / 5 second hold
❖ Hip Bridge v. 2 (bent knees)	2 / 5 second hold
❖ Hip Bridge v. 3 (straight legs)	2 / 5 second hold

Rubrics for Exercise Execution (10 points/exercise) Total: 110 points

QUALITATIVE DESCRIPTION	POINTS	CRITERIA
OUTSTANDING	10	Student performed the correct execution (form), repetition, and breathing of the exercise. The student has mastered the exercise.
SATISFACTORY	7	The student performed the exercise with a mistake in either: correct execution (form), repetition, or breathing.
UNSATISFACTORY	5	The student performed the exercise with 2-3 mistakes in either: correct execution (form), repetition, or breathing.
NEEDS IMPROVEMENT	3	The student performed the exercise with 4 or more mistakes in either: correct execution (form), repetition, and/or breathing.

REFERENCES

1. Corbin, C. B., Welk, G. J., Corbin, W. R., and Welk, K. A. (2013) *Concepts of Fitness and Wellness: A Comprehensive Lifestyle Approach, 10th Edition*. McGraw-Hill, New York:NY.
2. Video: Cornell University. Core Strengthening and Back Pain Prevention Exercises.
3. Video: Cornell University. Chair Stretches Exercise Routine